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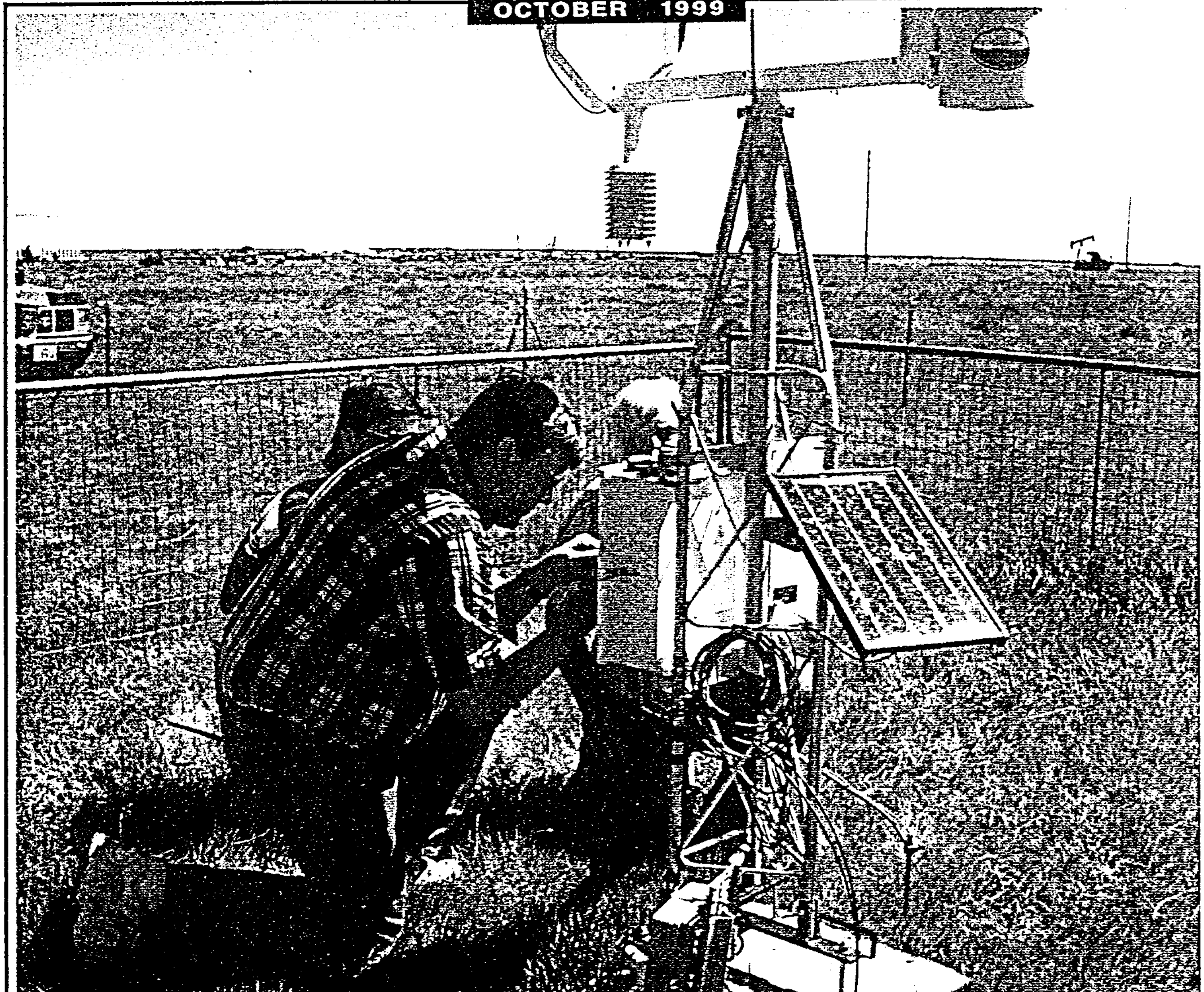

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ENGINEERING & TECHNOLOGY FOR A SUSTAINABLE WORLD

Weather Station Networks

Data helps improve irrigated agriculture

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The United Nations Food and Agriculture Organization (FAO) reported there were 53 million acres (21 million hectares) of U.S. irrigated land in 1996, which represented about 9% of the world's irrigated lands. About 75% of the world's irrigated land is in developing countries.

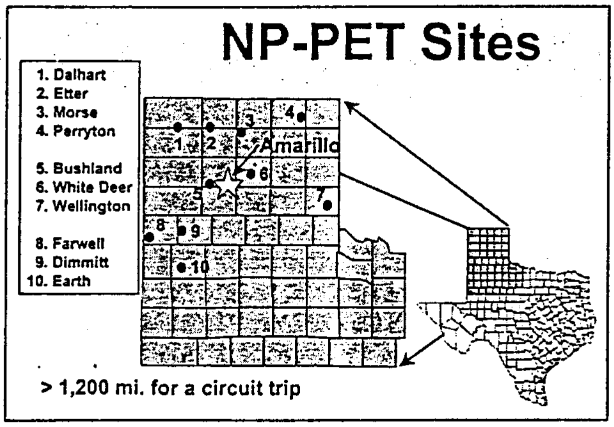
David Seckler, director general of the International Water Management Institute in Sri Lanka, says net worldwide irrigation expansion has decreased due to problems such as salinity and water logging. But the need to expand food production continues as the world's population grows. Sustained production from currently irrigated lands and enhanced production from degraded irrigated lands demands more attention throughout the world.

Irrigation is the largest use of water in the Texas high plains, a region with more than 4 million acres (1.6 million hectares) of irrigated crops. In the northern 26 counties of the Texas panhandle, called the Amarillo trade area, annual crop production revenue exceeds $770 million and estimated agribusiness economic impact is more than $3.25 billion.

The region produces more than 30% of U.S. fed beef and 50% of Texas corn and wheat. The area depends on the Ogallala aquifer for most of its water supply, but this resource is shrinking.

Despite irrigation method changes over the past 20 years, some areas in the region still experience water table decline rates exceeding 2 feet (0.6 meters) per year. Advanced irrigation scheduling is rarely used in this region but could further reduce applications and help sustain irrigation.

The computer era has improved irrigation scheduling. In the late 1960s and 1970s, Marvin Jensen, then with ARS in Idaho, worked with the U.S. Bureau of Reclamation to develop mainframe programs. These helped with the tedious computations needed for the Penman equation and field-by-field water balance calculations.



The NP-PET operates 10 weather stations across the central and northern Texas panhandle.

Today, this function is accomplished easier and faster using spreadsheets and/or programs used on PCs or laptop computers, which now exceed the computing power of the older mainframe computers.

Automated weather stations became available in the early 1980s following the handful of manual weather stations that previously recorded data. Today, weather station networks conduct irrigation scheduling in the western, southwestern and midwestern United States and elsewhere throughout the world.

Nebraska and California networks are some of the most extensive and well-established for irrigation scheduling. The Oklahoma Mesonet network is likely the most complete statewide network. The Minnesota-Wisconsin network uses the National Oceanic and Atmospheric Administration (NOAA) Geostationary Operational Environmental Satellite (GOES-8) data for regional estimates of solar irradiance for input into models to estimate crop water use.

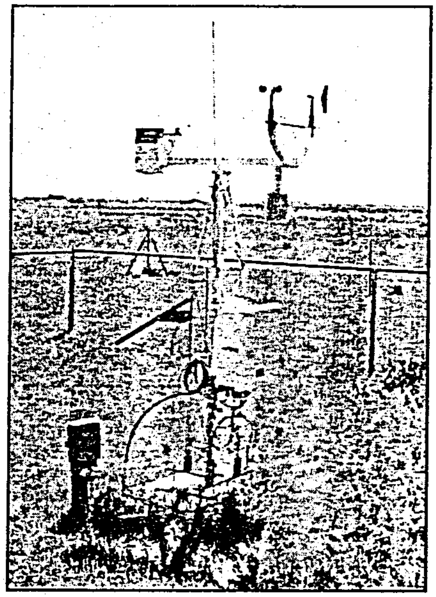
Private consulting companies use the data for weather stations and/or networks to customize farm and field irrigation scheduling products. The information can be uploaded directly to controllers on center-pivot and/or drip irrigation systems to reduce labor and enhance reliability.

In 1994, a Texas Agricultural Experiment Station (TAES), Texas Agricultural Extension Service (TAEX) and USDA-ARS team at Amarillo-Bushland-Etter developed a weather station network called the North Plains-Potential EvapoTranspiration (NP-PET) to serve the northern Texas panhandle. The system was similar to a three-station network developed in 1992 by TAES and TAEX on the south plains in Lubbock, Texas.

The earlier South Plains (SP) -PET network was primarily used for cotton, while the NP-PET network was for corn, wheat, sorghum, cotton, soybeans and peanuts. The NP-PET team sought input from growers and crop/irrigation consultants before finalizing information delivery and format.

The NP-PET operates 10 weather stations across the central and northern Texas panhandle. Although the SP-PET and NP-PET networks are separate, they collaborate and use similar methods.

The NP-PET network follows ASAE Engineering Practice X505 as a guide and sends more than 325 faxes each night to a range of subscribers. Both of these networks maintain World Wide Web sites where faxes and archived data can be retrieved. The NP-PET archives provide hourly data and daily statistics including maximums, minimums and totals.



This NP-PET weather station collects data on a farm in Morse, Texas.

A similar network in Texas was developed in 1995 by Guy Fipps, associate professor and extension engineer at Texas A&M University. It now has more than 20 station sites from the Lower Rio Grande Valley to the Coastal Bend and Edwards aquifer regions, to north and central Texas. Plans for a Texas Mesonet system are being patterned after the Oklahoma Mesonet for complete electronic statewide weather information coverage.

The northern tier of stations is at Dalhart, Etter, Morse and Perryton. The central tier is at Bushland, White Deer and Wellington. The southern tier is at Farwell, Dimmitt and Earth.

NP-PET computers are at Bushland and call each station after midnight for weather data from the previous day. The computers process data and compute PET, heat units and crop water use.

Many users need more detailed data for their applications, especially consultants and industries that may be using more complex models. The NP-PET hourly data and fax sheets are available on the Amarillo Agricultural Research and Extension Center Web server. The data and fax files are updated daily and compressed into 10-day files.

The ARS team at Bushland measured high ET rates for wheat, corn, alfalfa and grass. The rates at Bushland were as high as any place else in the world. The events often occur in spring and early summer in the Texas high plains when wind speed is stronger, air is drier and skies are clearer than in summer.

TAEX, through the AgriPartner program, used extension specialists, county agents and several part-time employees to help monitor 5,200 acres (2,100 hectares) on 45 farms in 13 counties during 1998. The trials included 51 irrigation and plant development demonstrations on seven crops.

The data allowed the NP-PET data to be tested during one of the driest summers on record in the Texas high plains. The demonstrations recorded the grower-applied water and tracked soil water use and crop development rates. Crop development for corn, sorghum, wheat and peanuts matched the NP-PET growth stages, but data indicated that more improvements were needed in the cotton and soybean crop models.

The 1998 data were used to make modifications that will be evaluated in 1999 trials. The data will also be used to develop county water use estimates for the regional water plan database mandated by Senate Bill 1 passed by the Texas Legislature in 1998. The goal is to develop a statewide Texas water plan to meet projected water needs.

NP-PET network users manage 350,000 to 400,000 acres (141,700 to 161,900 hectares) of irrigated land and save an estimated 60,000 acre feet (74,000 milliliters) of groundwater. The savings is about $10 million in annual fuel savings for pumping, plus $8 million in reduced maintenance costs. The savings are high when considered with $25,000 in annual operating expenses.

The 1998 NP-PET data also helped regional producers improve crop yields on irrigated land.

A benefit more difficult to quantify is the partnering and ownership of the NP-PET by involved agencies and stakeholders including water districts, irrigation consultants, irrigation and utility companies, and agency partners such as the USDA-Natural Resource Conservation Service, West Texas A&M University and Texas A&M University.

The NP-PET helped agriculture through collaboration with urban residents who used the Water Smart Program of the TAEX Master Gardener Programs, especially in Potter and Randall Counties. Amarillo in 1998 adopted a watering schedule to address water and pressure distribution problems caused by that year's drought. R

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